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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/617,487	07/11/2003	C. Andre T. Salama	SALA:003	2844

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EXAMINER	
LEWIS, MONICA	
ART UNIT	PAPER NUMBER
2822	

DATE MAILED: 05/23/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	10/617,487	SALAMA ET AL.	
	Examiner	Art Unit	
	Monica Lewis	2822	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *11 July 2003*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-10* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-10* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *03 February 2004* is/are: a)☐ accepted or b)☒ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date *2/04*.
4) ☒ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

DETAILED ACTION

1. This office action is in response to the application filed July 11, 2003.

Drawings

2. The drawings are objected to as failing to comply with 37 CFR 1.84(p)(5) because they include the following reference character(s) not mentioned in the description: a) 26 (See Figure 2). Corrected drawing sheets in compliance with 37 CFR 1.121(d), or amendment to the specification to add the reference character(s) in the description in compliance with 37 CFR 1.121(b) are required in reply to the Office action to avoid abandonment of the application. Any amended replacement drawing sheet should include all of the figures appearing on the immediate prior version of the sheet, even if only one figure is being amended. The replacement sheet(s) should be labeled "Replacement Sheet" in the page header (as per 37 CFR 1.84(c)) so as not to obstruct any portion of the drawing figures. If the changes are not accepted by the examiner, the applicant will be notified and informed of any required corrective action in the next Office action. The objection to the drawings will not be held in abeyance.

Specification

3. The specification is objected to as failing to provide proper antecedent basis for the claimed subject matter (See Claims 8 and 9). See 37 CFR 1.75(d)(1) and MPEP § 608.01(o). Correction is required.

Claim Rejections - 35 USC § 112

4. The following is a quotation of the second paragraph of 35 U.S.C. 112:

> The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

5. Claims 2-10 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention. It is not clear what is meant by the following: a) the product of the doping concentration of the reduced surface field portion and the vertical thickness of the reduced surface field portion is about 2×10^{12} (See Claim 8); and b) the product of the doping concentration of the super junction pillars and a transverse pillar width is about 2×10^{12} (See Claim 9). It is not clear how the concentration and the thickness are both 2×10^{12} (See Claim 8). Additionally, it is not clear how the concentration and the width are both 2×10^{12} (See Claim 9). Finally, there are no metric units. For example, is it cm^3 or um.

Claim Rejections - 35 USC § 103

6. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

7. Claims 1-7 are rejected under 35 U.S.C. 103(a) as being unpatentable over Applicant's Prior Art in view of Kitagawa et al. (U.S. Patent No. 6,777,746).

In regards to claim 1, Applicant's Prior Art discloses the following:

a) a substrate (22) (For Example: See Figure 2);

b) an epitaxial layer (24) formed on the substrate (For Example: See Figure 2);

c) a well region (28) formed in the epitaxial layer (For Example: See Figure 2);

d) a source region formed in the well region (For Example: See Figure 2);

e) a drain region formed in the epitaxial layer (For Example: See Figure 2); and

f) a gate region located above at least a portion of the well region (For Example: See Figure 2).

In regards to claim 1, Applicant's Prior Art fails to disclose the following:

a) a split-drift region located between the source region and drain region.

However, Kitagawa et al. ("Kitagawa") discloses the use of a split-drift region (12 and 13) located between the source region (8) and drain region (10) (For Example: See Figure 4). It would have been obvious to one having ordinary skill in the art at the time the invention was made to modify the semiconductor of Applicant's Prior Art to include the use of a split-drift region located between the source region and drain region as disclosed in Kitagawa because it aids in providing a device with a low on state resistance (For Example: See Column 2 Lines 14-20).

Additionally, since Applicant's Prior Art and Kitagawa are both from the same field of endeavor, the purpose disclosed by Kitagawa would have been recognized in the pertinent art of Applicant's Prior Art.

In regards to claim 2, Applicant's Prior Art fails to disclose the following:

a) the split-drift region comprises a super junction portion and a reduced surface field portion.

However, Kitagawa discloses the use of a split-drift region that comprises a super junction portion and a reduced surface field portion (For Example: See Column 1 Lines 51-55 and Figure 4). It would have been obvious to one having ordinary skill in the art at the time the invention was made to modify the semiconductor of Applicant's Prior Art to include the use of a split-drift region that comprises a super junction portion and a reduced surface field portion as disclosed in Kitagawa because it aids in providing a device with a low on state resistance (For Example: See Column 2 Lines 14-20).

Additionally, since Applicant's Prior Art and Kitagawa are both from the same field of endeavor, the purpose disclosed by Kitagawa would have been recognized in the pertinent art of Applicant's Prior Art.

In regards to claim 3, Applicant's Prior Art fails to disclose the following:

a) the super junction portion is positioned adjacent to the well region.

However, Kitagawa discloses the use of the super junction portion positioned adjacent to the well region (For Example: See Column 1 Lines 51-55 and Figure 4). It would have been obvious to one having ordinary skill in the art at the time the invention was made to modify the semiconductor of Applicant's Prior Art to include the use of a super junction portion positioned adjacent to the well region as disclosed in Kitagawa because it aids in providing a device with a low on state resistance (For Example: See Column 2 Lines 14-20).

Additionally, since Applicant's Prior Art and Kitagawa are both from the same field of endeavor, the purpose disclosed by Kitagawa would have been recognized in the pertinent art of Applicant's Prior Art.

In regards to claim 4, Applicant's Prior Art fails to disclose the following:

a) the super junction portion comprises alternately arranged pillars of first and second conductivity types.

However, Kitagawa discloses the use of a super junction portion that comprises alternately arranged pillars of first and second conductivity types (For Example: See Figure 4). It would have been obvious to one having ordinary skill in the art at the time the invention was made to modify the semiconductor of Applicant's Prior Art to include the use of a super junction portion that comprises alternately arranged pillars of first and second conductivity types as disclosed in Kitagawa because it aids in providing a device with a low on state resistance (For Example: See Column 2 Lines 14-20).

Additionally, since Applicant's Prior Art and Kitagawa are both from the same field of endeavor, the purpose disclosed by Kitagawa would have been recognized in the pertinent art of Applicant's Prior Art.

In regards to claim 5, Applicant's Prior Art fails to disclose the following:

a) the reduced surface field portion is located adjacent to the drain region.

However, Kitagawa discloses the reduced surface field portion is located adjacent to the drain region (For Example: See Figure 4). It would have been obvious to one having ordinary skill in the art at the time the invention was made to modify the semiconductor of Applicant's Prior Art to include Kitagawa discloses the reduced surface field portion is located adjacent to

the drain region as disclosed in Kitagawa because it aids in providing a device with a low on state resistance (For Example: See Column 2 Lines 14-20).

Additionally, since Applicant's Prior Art and Kitagawa are both from the same field of endeavor, the purpose disclosed by Kitagawa would have been recognized in the pertinent art of Applicant's Prior Art.

In regards to claim 6, Applicant's Prior Art fails to disclose the following:

a) the reduced surface field portion comprises a first conductivity type and the substrate comprises a second conductivity type.

However, Kitagawa discloses the reduced surface field portion comprises a first conductivity type and the substrate (1) comprises a second conductivity type (For Example: See Figure 4). It would have been obvious to one having ordinary skill in the art at the time the invention was made to modify the semiconductor of Applicant's Prior Art to include Kitagawa discloses that the reduced surface field portion comprises a first conductivity type and the substrate comprises a second conductivity type as disclosed in Kitagawa because it aids in providing a device with a low on state resistance (For Example: See Column 2 Lines 14-20).

Additionally, since Applicant's Prior Art and Kitagawa are both from the same field of endeavor, the purpose disclosed by Kitagawa would have been recognized in the pertinent art of Applicant's Prior Art.

In regards to claim 7, Applicant's Prior Art fails to disclose the following:

a) the length of the reduced surface field portion is much less than the length of the super junction portion.

However, the applicant has not established the critical nature of the length of the reduced surface field portion is much less than the length of the super junction portion. "The law is

replete with cases in which the difference between the claimed invention and the prior art is some range or other variable within the claims. . . . In such a situation, the applicant must show that the particular range is critical, generally by showing that the claimed range achieves unexpected results relative to the prior art range." *In re Woodruff*, 919 F.2d 1575, 16 USPQ2d 1934 (Fed. Cir.1990). Therefore, it would have been obvious to one having ordinary skill in the art at the time the invention was made to have various ranges.

8. Claims 8 and 9, as far as understood, are rejected under 35 U.S.C. 103(a) as being unpatentable over Applicant's Prior Art in view of Kitagawa et al. (U.S. Patent No. 6,777,746) and Kawaguchi et al. (U.S. Patent No. 6,297,534).

In regards to claim 8, Applicant's Prior Art fails to disclose the following:

a) the product of the doping concentration of the reduced surface field portion and the vertical thickness of the reduced surface field portion is about 2×10^{12}.

However, Kawaguchi et al. ("Kawaguchi") discloses the product of the doping concentration is 1.0×10^{17} cm^{-3} (For Example: See Column 6 Lines 53-65). It would have been obvious to one having ordinary skill in the art at the time the invention was made to modify the semiconductor of Applicant's Prior Art to include Kawaguchi discloses that the product of the doping concentration is 1.0×10^{17} cm^{-3} as disclosed in Kawaguchi because it aids in providing a device with a low on resistance (For Example: See Column 2 Lines 1 and 2).

Additionally, since Applicant's Prior Art and Kawaguchi are both from the same field of endeavor, the purpose disclosed by Kawaguchi would have been recognized in the pertinent art of Applicant's Prior Art.

Finally, the applicant has not established the critical nature of the product of the doping concentration of the reduced surface field portion and the vertical thickness of the reduced

surface field portion is about 2 x 10^{12}. "The law is replete with cases in which the difference between the claimed invention and the prior art is some range or other variable within the claims. . . . In such a situation, the applicant must show that the particular range is critical, generally by showing that the claimed range achieves unexpected results relative to the prior art range." *In re Woodruff*, 919 F.2d 1575, 16 USPQ2d 1934 (Fed. Cir.1990). Therefore, it would have been obvious to one having ordinary skill in the art at the time the invention was made to have various ranges.

In regards to claim 9, Applicant's Prior Art fails to disclose the following:

a) the product of the doping concentration of the super junction pillars and a transverse pillar width is about 2 x 10^{12}.

However, Kawaguchi et al. discloses the product of the doping concentration is $1.0x10^{17}$ cm^{-3} (For Example: See Column 6 Lines 53-65). It would have been obvious to one having ordinary skill in the art at the time the invention was made to modify the semiconductor of Applicant's Prior Art to include Kawaguchi discloses that the product of the doping concentration is $1.0x10^{17}$ cm^{-3} as disclosed in Kawaguchi because it aids in providing a device with a low on resistance (For Example: See Column 2 Lines 1 and 2).

Additionally, since Applicant's Prior Art and Kawaguchi are both from the same field of endeavor, the purpose disclosed by Kawaguchi would have been recognized in the pertinent art of Applicant's Prior Art.

Finally, the applicant has not established the critical nature of the product of the doping concentration of the super junction pillars and a transverse pillar width is about 2 x 10^{12}. "The law is replete with cases in which the difference between the claimed invention and the prior art is some range or other variable within the claims. . . . In such a situation, the applicant must show

that the particular range is critical, generally by showing that the claimed range achieves unexpected results relative to the prior art range." *In re Woodruff*, 919 F.2d 1575, 16 USPQ2d 1934 (Fed. Cir.1990). Therefore, it would have been obvious to one having ordinary skill in the art at the time the invention was made to have various ranges.

9. Claim 10 is rejected under 35 U.S.C. 103(a) as being unpatentable over Applicant's Prior Art in view of Kitagawa et al. (U.S. Patent No. 6,777,746) and Disney et al. (U.S. Patent No. 6,815,293).

In regards to claim 10, Applicant's Prior Art fails to disclose the following:

a) an oxide layer formed over the split-drift region.

However, Kitagawa discloses the use of an oxide layer over a split-drift region (For Example: See Column 5 Lines 25-30). It would have been obvious to one having ordinary skill in the art at the time the invention was made to modify the semiconductor of Applicant's Prior Art to include the use of an oxide layer over a split-drift region as disclosed in Kitagawa because it aids in providing a device with a low on state resistance (For Example: See Column 2 Lines 14-20).

Additionally, since Applicant's Prior Art and Kitagawa are both from the same field of endeavor, the purpose disclosed by Kitagawa would have been recognized in the pertinent art of Applicant's Prior Art.

b) metal field plates formed on portions of the oxide layer adjacent to the gate region and the drain region.

However, Disney et al. ("Disney") discloses the use of a metal field plate (164) formed on an oxide layer (169) adjacent to the gate (75) and drain (For Example: See Figure 7c). It would have been obvious to one having ordinary skill in the art at the time the invention was

made to modify the semiconductor of Applicant's Prior Art to include the use of metal field plate formed on an oxide layer adjacent to the gate and drain as disclosed in Disney because it aids in providing a device that can withstand high voltages (For Example: See Column 1 Lines 15-20).

Additionally, since Applicant's Prior Art and Disney are both from the same field of endeavor, the purpose disclosed by Disney would have been recognized in the pertinent art of Applicant's Prior Art.

Conclusion

10. The following prior art made of record and not relied upon is considered pertinent to applicant's disclosure: a) Yamaguchi et al. (U.S. Publication No. 2003/0222327) discloses a semiconductor device; b) Yamauchi et al. (U.S. Publication No. 2003/0219933) discloses a semiconductor device having an epitaxially filled trench; c) Parthasarathy et al. (U.S. Publication No. 2003/0214009) discloses a resurf super junction device device; d) Onishi et al. (U.S. Publication No. 2004/02112032) discloses a lateral super junction device; e) Onishi et al. (U.S. Patent No. 6,756,636) discloses a lateral super junction device; and f) Kitagawa et al. (U.S. Publication No. 2004/0232483) discloses a field effect transistor.

11. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Monica Lewis whose telephone number is 571-272-1838. If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Amir Zarabian can be reached on 571-272-1852. The fax phone number for the organization where this application or proceeding is assigned is 703-308-7722 for regular and after final

communications. Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is 703-308-0956

ML
December 2, 2004

Mary Wilczewski
Primary Examiner